PROBLEMS

1. (a) $\frac{79.90}{20.18} = 3.959$ (b) $\frac{79.90}{40.08} = 1.994$ (c) $\frac{79.90}{4.003} = 19.96$

3. Ce-140

5. (c)

7. 83.9134(0.0056) + 85.9094(0.0986) + 86.9089(0.0700) + 87.9056(0.8258) = 0.47 + 8.47 + 6.08 + 72.59

   average atomic mass = 87.61

9. $107.9 = 106.905(0.5184) + 0.4816x$; $x = 109.0$

11. Let x = abundance of the first isotope; abundance of third isotope = 1.0000 – (0.8787 + 0.02365) = 0.0976

    $51.9961 = 49.94605x + 51.94051(0.8787 - x) + 52.94065(0.09765) + 53.93888(0.02365)$

    $x = 0.0447$. Abundance of first isotope = 4.47%; second = 83.40%; third = 9.76%.

13. Tall peak at mass-20; peak about 1/10 as high at mass-22; very small peak at mass-21.

15. (a) 6.022×10^{23} (b) $6.022 \times 10^{14}/15 = 4.051 \times 10^{13}$

17. (a) $3 \times 10^{-7}\,\text{g} \times \frac{1\,\text{mol}}{207.2\,\text{g}} \times \frac{6.022 \times 10^{23}\,\text{atoms}}{1\,\text{mol}} = 9 \times 10^{14}\,\text{atoms}$

    (b) $1.00\,\text{L} \times \frac{10^3\,\text{mL}}{1\,\text{L}} \times \frac{3 \times 10^{-7}\,\text{g}}{1.00\,\text{mL}} \times \frac{1\,\text{mol}}{207.2\,\text{g}} = 1 \times 10^{-6}\,\text{mol}$

19. (a) $0.357\,\text{mol} \times 197.0\,\text{g/mol} = 70.3\,\text{g}$

    (b) $0.357\,\text{g} \times \frac{1\,\text{mol}}{197.0\,\text{g}} \times \frac{6.022 \times 10^{23}\,\text{atoms}}{1\,\text{mol}} = 1.09 \times 10^{21}\,\text{atoms}$

    (c) $1.09 \times 10^{21}\,\text{atoms} \times \frac{79\,e^-}{1\,\text{atom}} \times \frac{1\,\text{mol}\,e^-}{6.022 \times 10^{23}\,e^-} = 0.143\,\text{mol}\,e^-$

21. (a) $10.0000\,\text{g} \times \frac{1\,\text{mol}}{27.977\,\text{g}} = 0.35744\,\text{mol}$

    (b) $0.35744\,\text{mol} \times \frac{6.022 \times 10^{23}\,\text{atoms}}{1\,\text{mol}} = 2.152 \times 10^{23}\,\text{atoms}$

    (c) $2.152 \times 10^{23}\,\text{atoms} \times \frac{(14\,p^+ + 14\,n + 14\,e^-)}{1\,\text{atom}} = 9.039 \times 10^{24}$

23. $V_{\text{cube}} = \left(1.25\,\text{in} \times \dfrac{2.54\ \text{cm}}{1\ \text{in}}\right)^3 = 32.0\ \text{cm}^3$

$$32.0\,\text{cm}^3 \times \frac{0.968\,\text{g}}{1\ \text{cm}^3} \times \frac{6.022 \times 10^{23}\ \text{atoms}}{22.99\,\text{g}} = 8.12 \times 10^{23}\ \text{atoms}$$

25. (a) $(12 \times 12.01 + 22 \times 1.008 + 11 \times 16.00)\ \text{g/mol} = 342.3\ \text{g/mol}$

(b) $(2 \times 14.01 + 16.00)\ \text{g/mol} = 44.02\ \text{g/mol}$

(c) $(20 \times 12.01 + 30 \times 1.008 + 16.00)\ \text{g/mol} = 286.44\ \text{g/mol}$

27. (a) $4.00 \times 10^3\ \text{g}\ N_2H_4 \times \dfrac{1\ \text{mol}\ N_2H_4}{32.05\,\text{g}\ N_2H_4} = 125\,\text{mol}$

(b) $12.5\,\text{g}\ SnF_2 \times \dfrac{1\ \text{mol}\ SnF_2}{156.7\,\text{g}\ SnF_2} = 0.0798\,\text{mol}$

(c) $13 \times \dfrac{1\ \text{mol}}{97.10\,\text{g}} = 0.13\,\text{mol}$

29. (a) $2.688\,\text{mol} \times 893.47\,\text{g/mol} = 2.402 \times 10^3\ \text{g}$

(b) $2.688\,\text{mol} \times 218.20\,\text{g/mol} = 586.5\,\text{g}$

(c) $2.688\,\text{mol} \times 262.26\,\text{g/mol} = 705.0\,\text{g}$

31. MM = 227.14 g/mol

	No. of grams	No. of moles	No. of molecules	No. of N atoms
(a)	127.2	0.5600	3.372×10^{23}	1.012×10^{24}
(b)	210.2	0.9254	5.573×10^{23}	1.672×10^{24}
(c)	4.68×10^6	2.04×10^4	1.24×10^{28}	3.72×10^{28}
(d)	9.4	0.042	2.5×10^{22}	7.5×10^{22}

33. MM = $(63.55 + 6 \times 26.98 + 4 \times 30.97 + 28 \times 16.00 + 16 \times 1.008)\ \text{g/mol} = 813.44\ \text{g/mol}$

Cu: $\dfrac{63.55 \times 100}{813.44} = 7.812\%$; Al : $\dfrac{161.88 \times 100}{813.44} = 19.90\%$; P : $\dfrac{123.88 \times 100}{813.44} = 15.23\%$;

O: $\dfrac{448.00 \times 100}{813.44} = 55.07\%$; H : $\dfrac{16.128 \times 100}{813.44} = 1.983\%$.

35. MM = $(12 \times 12.01 + 17 \times 1.008 + 14.01 + 16.00)$ g/mol = 191.27 g/mol

$$127\text{ g DEET} \times \frac{144.12\text{ g C}}{191.27\text{ g DEET}} = 95.7\text{ g C}$$

37. (a) $\frac{0.251\text{ g}}{0.611\text{ g}} \times 100 = 41.1\%$

(b) MM $C_8H_9NO_2$ = [8(12.01) + 9(1.008) + 1(14.01) + 2(16.00)] g/mol = 151.16 g/mol

$$0.611\text{ g tyl.} \times 0.411 \times \frac{14.01}{151.16} = 0.0233\text{ g N}$$

39. mass % C = $2.90\text{ g }CO_2 \times \frac{12.01\text{ g C}}{44.01\text{ g }CO_2} \times 100\% = 79.1\%$

mass % H = $0.875\text{ g }H_2O \times \frac{2.016\text{ g H}}{18.0\text{ g }H_2O} \times 100\% = 9.80\%$

mass % O = 100% − 79.1% − 9.8% = 11.1%

41. Assume 100.0 g of compound; mass Cl = 70.3 g; mass X = 100.0 – 70.3 = 29.7 g

$$70.3\text{ g Cl} \times \frac{1\text{ mol Cl}}{35.45\text{ g Cl}} = 1.98\text{ mol Cl} \times \frac{1\text{ mol X}}{3\text{ mol Cl}} = 0.661\text{ mol X}$$

MM of X = $\frac{29.7\text{ g}}{0.661\text{ mol}} = 44.9$ g/mol; MM of $XCl_3 = 44.9 + 3(35.45) = 151.3$ g/mol. So X is scandium (Sc).

43. mol P = $\frac{1.347\text{ g}}{30.97\text{ g/mol}} = 0.04349$; mol O = $\frac{1.744\text{ g}}{16.00\text{ g/mol}} = 0.1090$ mol;

$\frac{0.1090\text{ mol O}}{0.04349\text{ mol P}} = \frac{2.5\text{ mol O}}{1\text{ mol P}}$; P_2O_5 (phosphorous pentoxide)

45. (a) In 100.00 g of MSG:

mol C = $\frac{35.51\text{ g}}{12.01\text{ g/mol}} = 2.957$ mol H = $\frac{4.77\text{ g}}{1.008\text{ g/mol}} = 4.73$ mol O = $\frac{37.85\text{ g}}{16.00\text{ g/mol}} = 2.366$

mol N = $\frac{8.29\text{ g}}{14.01\text{ g/mol}} = 0.592$ mol Na = $\frac{13.60\text{ g}}{22.99\text{ g/mol}} = 0.5916$

1 Na : 1 N : 4 O : 5 C : 8 H Hence, $C_5H_8O_4NNa$.

(b) mol O = $\frac{34.91\text{ g}}{16.00\text{ g/mol}} = 2.182$ mol Si = $\frac{15.32\text{ g}}{28.09\text{ g/mol}} = 0.5454$ mol Zr = $\frac{49.76\text{ g}}{91.22\text{ g/mol}} = 0.5455$

1 Si : 1 Zr : 4 O. Hence, $ZrSiO_4$.

(c) mol C = $\dfrac{74.0 \text{ g}}{12.01 \text{ g/mol}} = 6.16$ mol H = $\dfrac{8.65 \text{ g}}{1.008 \text{ g/mol}} = 8.58$ mol N = $\dfrac{17.4 \text{ g}}{14.01 \text{ g/mol}} = 1.24$

1 N : 5 C : 7 H . Hence, C_5H_7N.

47. mass C = $13.86 \text{ g } CO_2 \times \dfrac{12.01 \text{ g C}}{44.01 \text{ g } CO_2} = 3.782 \text{ g}$ mass H = $3.926 \text{ g } H_2O \times \dfrac{2.016 \text{ g H}}{18.02 \text{ g } H_2O} = 0.4392 \text{ g}$

mass O = 5.000 g − 3.782 g − 0.4392 g = 0.779 g

mol C = $\dfrac{3.782 \text{ g}}{12.01 \text{ g/mol}} = 0.3149$ mol H = $\dfrac{0.4392 \text{ g}}{1.008 \text{ g/mol}} = 0.4357$ mol O = $\dfrac{0.779 \text{ g}}{16.00 \text{ g/mol}} = 0.0487$

1 O : 6.5 C : 9 H . Hence, $C_{13}H_{18}O_2$.

49. mass C = $8.692 \text{ g } CO_2 \times \dfrac{12.01 \text{ g C}}{44.01 \text{ g } CO_2} = 2.372 \text{ g}$ mass H = $1.142 \text{ g } H_2O \times \dfrac{2(1.008) \text{ g H}}{18.02 \text{ g } H_2O} = 0.1278 \text{ g}$

mass Cl = $2.571 \text{ g HCl} \times \dfrac{35.45 \text{ g Cl}}{36.46 \text{ g HCl}} = 2.500 \text{ g}$

mol C = $\dfrac{2.372 \text{ g}}{12.01 \text{ g/mol}} = 0.1975$ mol H = $\dfrac{0.1278 \text{ g}}{1.008 \text{ g/mol}} = 0.1268$ mol Cl = $\dfrac{2.500 \text{ g}}{35.45 \text{ g/mol}} = 0.07052$

1 Cl : 1.8 H : 2.8 C . Hence, $C_{14}H_9Cl_5$

51. mass C = $14.36 \text{ g } CO_2 \times \dfrac{12.01 \text{ g C}}{44.01 \text{ g } CO_2} = 3.919 \text{ g}$ mass H = $7.832 \text{ g } H_2O \times \dfrac{2(1.008) \text{ g H}}{18.02 \text{ g } H_2O} = 0.8762 \text{ g}$

mass N = 6.315 − 3.919 − 0.876 = 1.520 g

mol C = $\dfrac{3.919 \text{ g}}{12.01 \text{ g/mol}} = 0.3263$ mol H = $\dfrac{0.8762 \text{ g}}{1.008 \text{ g/mol}} = 0.8692$ mol N = $\dfrac{1.520 \text{ g}}{14.01 \text{ g/mol}} = 0.1085$

1 N : 3 C : 8 H . Simplest formula: C_3H_8N; formula mass = 58.0 g; 116/58 = 2

Molecular formula: $C_6H_{16}N_2$.

53. MM $KAl(SO_4)_2$ = (39.10 + 26.98 + 64.14 + 128.00) g/mol = 258.2 g/mol

mol alum = $\dfrac{2.583 \text{ g}}{258.2 \text{ g/mol}} = 0.0100$ mol H_2O = $\dfrac{2.876 \text{ g}}{18.02 \text{ g/mol}} = 0.1596$

$x = \dfrac{0.1596}{0.0100} = 16.$ mass % H_2O = $\dfrac{2.876 \text{ g}}{(2.876 + 2.583) \text{ g}} \times 100\% = 52.68\%$

55. (a) $CaC_2(s) + 2\,H_2O(l) \rightarrow Ca(OH)_2(s) + C_2H_2(g)$

(b) $(NH_4)_2Cr_2O_7(s) \rightarrow Cr_2O_3(s) + N_2(g) + 4\,H_2O(g)$

(c) $4\,CH_3NH_2(g) + 9\,O_2(g) \rightarrow 4\,CO_2(g) + 2\,N_2(g) + 10\,H_2O(g)$

57. (a) $2\,K(s) + S(s) \rightarrow K_2S(s)$

(b) $Mg(s) + S(s) \rightarrow MgS(s)$

(c) $2\,Al(s) + 3\,S(s) \rightarrow Al_2S_3(s)$

(d) $Ca(s) + S(s) \rightarrow CaS(s)$

(e) $Fe(s) + S(s) \rightarrow FeS(s)$

59. (a) $C_6H_{12}O_6(s) + 6\,O_2(g) \rightarrow 6\,CO_2(g) + 6\,H_2O(l)$

(b) $XeF_4(g) + 2\,H_2O(l) \rightarrow Xe(g) + O_2(g) + 4\,HF(g)$

(c) $2\,Al(s) + Fe_2O_3(s) \rightarrow 2\,Fe(s) + Al_2O_3(s)$

(d) $N_2(g) + 3\,H_2(g) \rightarrow 2\,NH_3(g)$

(e) $4\,NaCl(s) + 2\,SO_2(g) + 2\,H_2O(g) + O_2(g) \rightarrow 2\,Na_2SO_4(s) + 4\,HCl(g)$

61. (a) $1.37\text{ mol }C_2N_2 \times \frac{7\text{ mol }F_2}{1\text{ mol }C_2N_2} = 9.59\text{ mol }F_2$

(b) $13.75\text{ mol }F_2 \times \frac{2\text{ mol }CF_4}{7\text{ mol }F_2} = 3.929\text{ mol }CF_4$

(c) $0.8974\text{ mol }NF_3 \times \frac{1\text{ mol }C_2N_2}{2\text{ mol }NF_3} = 0.4487\text{ mol }C_2N_2$

(d) $4.981\text{ mol }NF_3 \times \frac{7\text{ mol }F_2}{2\text{ mol }NF_3} = 17.43\text{ mol }F_2$

63. (a) $0.839\text{ mol }NH_3 \times \frac{6\text{ mol }H_2O}{4\text{ mol }NH_3} \times \frac{18.02\text{ g }H_2O}{1\text{ mol }H_2O} = 22.7\text{ g }H_2O$

(b) $3.402\text{ mol }NH_3 \times \frac{6\text{ mol NO}}{4\text{ mol }NH_3} \times \frac{30.01\text{ g NO}}{1\text{ mol NO}} = 153.1\text{ g NO}$

(c) $12.0\text{ g }N_2 \times \frac{1\text{ mol }N_2}{28.02\text{ g }N_2} \times \frac{4\text{ mol }NH_3}{5\text{ mol }N_2} \times \frac{17.02\text{ g }NH_3}{1\text{ mol }NH_3} = 5.83\text{ g }NH_3$

(d) $115\text{ g NO} \times \frac{1\text{ mol NO}}{30.01\text{ g NO}} \times \frac{4\text{ mol }NH_3}{6\text{ mol NO}} \times \frac{17.02\text{ g }NH_3}{1\text{ mol }NH_3} = 43.5\text{ g }NH_3$

65. (a) $2\,C_2H_3Cl(l) + 5\,O_2(g) \rightarrow 4\,CO_2(g) + 2\,HCl(g) + 2\,H_2O(g)$

(b) $35.00\text{ g }C_2H_3Cl \times \frac{1\text{ mol }C_2H_3Cl}{62.49\text{ g }C_2H_3Cl} \times \frac{5\text{ mol }O_2}{2\text{ mol }C_2H_3Cl} = 1.400\text{ mol }O_2$

(c) $25.00\,g\ C_2H_3Cl \times \frac{1\,mol\ C_2H_3Cl}{62.49\,g\ C_2H_3Cl} \times \frac{4\,mol\ CO_2}{2\,mol\ C_2H_3Cl} \times \frac{44.01\,g\ CO_2}{1\,mol\ CO_2} = 35.21\,g\ CO_2$

$25.00\,g\ C_2H_3Cl \times \frac{1\,mol\ C_2H_3Cl}{62.49\,g\ C_2H_3Cl} \times \frac{2\,mol\ HCl}{2\,mol\ C_2H_3Cl} \times \frac{36.46\,g\ HCl}{1\,mol\ HCl} = 14.59\,g\ HCl$

$25.00\,g\ C_2H_3Cl \times \frac{1\,mol\ C_2H_3Cl}{62.49\,g\ C_2H_3Cl} \times \frac{2\,mol\ H_2O}{2\,mol\ C_2H_3Cl} \times \frac{18.02\,g\ H_2O}{1\,mol\ H_2O} = 7.209\,g\ H_2O$

67. (a) $C_2H_5OH(l) + 3\,O_2(g) \rightarrow 2\,CO_2(g) + 3\,H_2O(l)$

(b) $1.25 \times 10^3\ g\ H_2O \times \frac{1\,mol\ H_2O}{18.02\,g\ H_2O} \times \frac{1\,mol\ C_2H_5OH}{3\,mol\ H_2O} \times \frac{46.07\,g\ C_2H_5OH}{1\,mol\ C_2H_5OH} \times \frac{1\,L}{789\,g\ C_2H_5OH}$

$= 1.35\,L\ C_2H_5OH$

(c) $3.12\,L \times \frac{1.80\,g\ CO_2}{1\,L} \times \frac{1\,mol\ CO_2}{44.01\,g\ CO_2} \times \frac{1\,mol\ C_2H_5OH}{2\,mol\ CO_2} \times \frac{46.07\,g\ C_2H_5OH}{1\,mol\ C_2H_5OH} \times \frac{100\,g\ cooler}{4.5\,g\ C_2H_5OH}$

$= 65\,g\ cooler$

69. $1.00 \times 10^7\ g\ oil \times \frac{1.2\,g\ S}{100.0\,g\ oil} \times \frac{1\,mol\ S}{32.07\,g\ S} \times \frac{1\,mol\ SO_2}{1\,mol\ S} \times \frac{64.07\,g\ SO_2}{1\,mol\ SO_2} \times \frac{1\,L}{2.60\,g\ SO_2} = 9.2 \times 10^4\ L$

71. (a) $10.0\,g\ A_2B_3 \times \frac{1\,mol\ A_2B_3}{255\,g\ A_2B_3} \times \frac{4\,mol\ A_4X_3}{8\,mol\ A_2B_3} = 0.0196\,mol\ A_4X_3$

(b) $MM = \frac{4.00\,g}{0.0196\,mol} = 204\,g/mol$

73. (a) $2\,H_2(g) + O_2(g) \rightarrow 2\,H_2O(g)$

(b) If H_2 is limiting: $4.15\,mol\ H_2 \times \frac{2\,mol\ H_2O}{2\,mol\ H_2} = 4.15\,mol\ H_2O$

If O_2 is limiting: $7.13\,mol\ O_2 \times \frac{2\,mol\ H_2O}{1\,mol\ O_2} = 14.26\,mol\ H_2O$

Hence, H_2 is limiting.

(c) 4.15 mol

(d) $4.15\,mol\ H_2 \times \frac{1\,mol\ O_2}{2\,mol\ H_2} = 2.08\,mol\ O_2$ reacts; so $7.13 - 2.08 = 5.05$ mol unreacted.

75. (a) $2\,KClO_3(s) \rightarrow 2\,KCl(s) + 3\,O_2(g)$

(b) $198.5\,g\ O_2 \times \frac{1\,mol\ O_2}{32.00\,g\ O_2} \times \frac{2\,mol\ KClO_3}{3\,mol\ O_2} \times \frac{122.6\,g\ KClO_3}{1\,mol\ KCLO_3} = 507.0\,g$ $\quad \frac{507.0\,g}{0.832} = 609\,g$

77. (a) If C_2H_2 is limiting: $175\text{ g } C_2H_2 \times \frac{1\text{ mol } C_2H_2}{26.04\text{ g } C_2H_2} \times \frac{4\text{ mol } CO_2}{2\text{ mol } C_2H_2} \times \frac{44.01\text{ g } CO_2}{1\text{ mol } CO_2} = 592\text{ g } CO_2$

If O_2 is limiting: $175\text{ g } O_2 \times \frac{1\text{ mol } O_2}{32.00\text{ g } O_2} \times \frac{4\text{ mol } CO_2}{5\text{ mol } O_2} \times \frac{44.01\text{ g } CO_2}{1\text{ mol } CO_2} = 193\text{ g } CO_2$

Since O_2 is limiting, the theoretical yield is 193 g CO_2

(b) Percent yield $= \frac{(68.5\text{ L})(1.85\text{ g/L})}{193\text{ g}} \times 100 = 65.7\%$

(c) $175\text{ g } O_2 \times \frac{1\text{ mol } O_2}{32.00\text{ g } O_2} \times \frac{2\text{ mol } C_2H_2}{5\text{ mol } O_2} \times \frac{26.04\text{ g } C_2H_2}{1\text{ mol } C_2H_2} = 57.0\text{ g } C_2H_2$ reacted

mass of C_2H_2 left $= 175 - 57 = 118\text{ g}$

79. $0.850 = \frac{45.0\text{ g}}{\text{theoretical yield}}$, so theoretical yield = 52.9 g of aspirin

$$\text{mass } C_7H_6O_3 = 52.9\text{ g } C_9H_8O_4 \times \frac{1\text{ mol } C_9H_8O_4}{180.1\text{ g } C_9H_8O_4} \times \frac{1\text{ mol } C_7H_6O_3}{1\text{ mol } C_9H_8O_4} \times \frac{138.1\text{ g } C_7H_6O_3}{1\text{ mol } C_7H_6O_3} = 40.9\text{ g}$$

$$\text{mass } C_4H_6O_3 = 52.9\text{ g } C_9H_8O_4 \times \frac{1\text{ mol } C_9H_8O_4}{180.1\text{ g } C_9H_8O_4} \times \frac{1\text{ mol } C_4H_6O_3}{1\text{ mol } C_9H_8O_4} \times \frac{102.1\text{ g } C_4H_6O_3}{1\text{ mol } C_4H_6O_3}$$

$$= 30.0\text{ g} + 0.550(30.0)\text{ g} = 46.5\text{ g}$$

81. $\$3000 \times \frac{1\text{ troy oz Pt}}{\$1118.00} \times \frac{31.1\text{ g Pt}}{1\text{ troy oz}} \times \frac{300.1\text{ g cisplatin}}{195.1\text{ g Pt}} \times \frac{1\text{ lb}}{454\text{ g}} = 0.283\text{ lb}$

83. (a) ≈ 0.75 g (b) Fe (c) O_2 (d) 3.0 g (e) Fe_2O_3

85. $$6.00\text{ oz salami} \times \frac{1\text{ g salami}}{0.03527\text{ oz}} \times \frac{0.090\text{ g } NaC_7H_5O_2}{100\text{ g salami}} \times \frac{1\text{ mol } NaC_7H_5O_2}{144.1\text{ g}} \times \frac{1\text{ mol Na}}{1\text{ mol } NaC_7H_5O_2}$$

$$\times \frac{6.022 \times 10^{23}\text{ atoms}}{1\text{ mol Na}} = 6.4 \times 10^{20}\text{ Na atoms}$$

87. $\frac{50\text{ lb}}{1\text{ bag}} \times \frac{454\text{ g}}{1\text{ lb}} = 2.27 \times 10^4\text{ g/bag}$ urea: $2.27 \times 10^4 \times \frac{28\text{ g N}}{60\text{ g } (NH_2)_2CO} = 1.1 \times 10^4\text{ g N}$

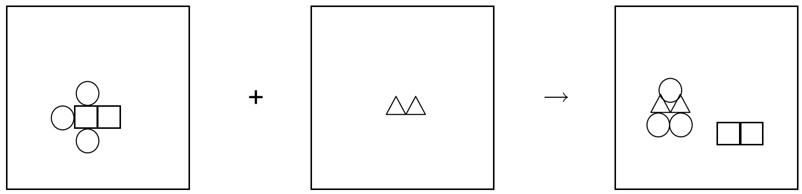
NH_3 : $2.27 \times 10^4 \times \frac{14\text{ g N}}{17\text{ g } NH_3} = 1.9 \times 10^4\text{ g N}$

NH_4NO_3 : $2.27 \times 10^4 \times \frac{28\text{ g N}}{80\text{ g } NH_4NO_3} = 7.9 \times 10^3\text{ g N}$

$HNC(NH_2)_2$: $2.27 \times 10^4 \times \frac{42\text{ g N}}{59\text{ g } HNC(NH_2)_2} = 3.9 \times 10^2\text{ g}$ Hence, NH_3 will cost the least.

89. (a) B (b) C c) F (d) same number of atoms/mole

91.



A_2B_3 C_2 C_2B_3 A_2

93. (a) $X + 3\,Y \rightarrow XY_3$ (b) 5 mol X + 10 mol Y (c) 3 mol XY_3; 2 mol X; 1 mol Y

95. no. C atoms = $5.000 \times 10^3\ \text{g} \times \dfrac{6.022 \times 10^{23}\ \text{atoms}}{12.00\ \text{g}} = 2.509 \times 10^{26}\ \text{atoms} = N_A$

97. (a) EQ (b) LT (c) LT (d) $4\,PH_3(g) + 8\,O_2(g) \rightarrow P_4O_{10}(s) + 6\,H_2O(g)$; GT

(e) GT

99. $2.72 = \dfrac{24.30\ \text{g Mg}}{x\ \text{g chlorophyll}} \times 100 \quad \rightarrow \quad \text{MM} = 893\ \text{g/mol}$

100. $107.9\ \text{g} \times \dfrac{1\ \text{cm}^3}{10.5\ \text{g}} \times \dfrac{10^{21}\ \text{nm}^3}{1\ \text{cm}^3} \times \dfrac{4\ \text{atoms}}{(0.409\ \text{nm})^3} = 6.01 \times 10^{23}\ \text{atoms}$

101. mass CaO = $4.832\ \text{g Ca(OH)}_2 \times \dfrac{1\ \text{mol Ca(OH)}_2}{74.10\ \text{g Ca(OH)}_2} \times \dfrac{1\ \text{mol CaO}}{1\ \text{mol Ca(OH)}_2} \times \dfrac{56.08\ \text{g CaO}}{1\ \text{mol CaO}} = 3.657\ \text{g CaO}$

mass Ca to CaO = $3.657\ \text{g CaO} \times \dfrac{40.08\ \text{g Ca}}{56.08\ \text{g CaO}} = 2.614\ \text{g Ca}$

mass Ca to Ca_3N_2 = $5.025\ \text{g} - 2.614\ \text{g} = 2.411\ \text{g}$

mass Ca_3N_2 = $2.411\ \text{g Ca} \times \dfrac{148.26\ \text{g Ca}_3\text{N}_2}{120.24\ \text{g Ca}} = 2.973\ \text{g Ca}_3\text{N}_2$

102. Initially: $95.0\ \text{g}/(137.34\ \text{g/mol}) = 0.692$ mol Ba; $50.0\ \text{g}/(32.06\ \text{g/mol}) = 1.56$ mol S

$65.15\ \text{g BaS} \times \dfrac{1\ \text{mol BaS}}{169.4\ \text{g BaS}} \times \dfrac{1\ \text{mol Ba}}{1\ \text{mol BaS}} = 0.385$ mol Ba used by BaS

mol Ba left = $0.692 - 0.385 = 0.306$

$0.385\ \text{mol BaS} \times \dfrac{1\ \text{mol S}}{1\ \text{mol BaS}} = 0.385$ mol S used by BaS; mol S left = $1.56 - 0.385 = 1.18$

$2\,Ba(s) + O_2(g) \rightarrow 2\,BaO(s)$

$0.306\ \text{mol Ba} \times \dfrac{2\ \text{mol BaO}}{2\ \text{mol Ba}} \times \dfrac{153.3\ \text{g BaO}}{1\ \text{mol BaO}} = 46.9\ \text{g BaO}$

$S(s) + O_2(g) \rightarrow SO_2(g)$

$$1.18\text{ mol S} \times \frac{1\text{ mol SO}_2}{1\text{ mol S}} \times \frac{64.06\text{ g SO}_2}{1\text{ mol SO}_2} = 75.6\text{ g SO}_2$$

103. Let x = mass KBr. Then $3.595\text{ g} - x + \frac{x(74.55)}{119.0} = 3.129\text{ g}$; $x = 1.25\text{ g}$

$$\%\text{ KBr} = \frac{1.25\text{ g}}{3.595\text{ g}} \times 100 = 34.7\%$$

104. (a) 1st oxide: 2.573 g V(0.05051 mol) + 2.016 g O(0.1260 mol O)

$0.1260/0.05051 = 2.49$; V_2O_5

2nd oxide: 2.573 g V(0.05051 mol) + 1.209 g O(0.07556 mol O)

$0.07556/0.05051 = 1.50$; V_2O_3

(b) $2.016\text{ g O} \times \frac{18.02\text{ g H}_2\text{O}}{16.00\text{ g O}} = 2.271\text{ g H}_2\text{O}$

105. $C_{17}H_{21}O_4N \rightarrow 17\,CO_2$ $C_{12}H_{22}O_{11} \rightarrow 12\,CO_2$

Let x = mass of cocaine in a one-gram sample, which would produce one liter of CO_2

$$x \times \frac{748.17}{303.35} \times \frac{1}{1.80} + (1.00 - x)\frac{528.12}{342.30} \times \frac{1}{1.80} = 1.00$$

Solving, $x = 0.28$ g; 28%